

Remarks

Claims 1 through 32 are pending in this application. Applicants believe that the following remarks, in conjunction with the above claim amendments, place the claims in condition for allowance. Applicants respectfully request reconsideration of the application in view of the remarks.

Summary Of Claimed Invention

The invention is directed to a catalyst system for use with internal combustion engines to reduce noxious emissions when the engine is operated at both lean and stoichiometric air/fuel ratios. The catalyst system of this invention includes two catalysts. One of the catalysts is a lean NOx trap designed specifically to store NOx emissions under lean conditions, reduce the stored NOx during rich operation and convert HC, CO and NOx under stoichiometric operation. This catalyst consists of two zones — a front cerium-free zone containing aluminum oxide, oxides of alkali metals, alkaline earth metals and a high loading of precious metals, and a second zone of oxides of aluminum, alkali metals, alkaline earth metals, rare earth metals, or combinations thereof, and a lower loading of precious metals. The second catalyst is designed specifically to optimize the conversion of HC, CO and NOx under stoichiometric operations. The second catalyst also stores any NOx emitted from the first catalyst during lean operation and converts the stored NOx during the rich purges. The second catalyst contains precious metals, aluminum oxides and a higher concentration of mixed oxides of zirconium and cerium and alkali metals or alkaline earth metals such as barium oxide or magnesium oxide.

The first catalyst is a lean NOx trap, that solves the prior art problem of 1) "NOx release," the release of unreduced NOx from the NOx trap during the transition from lean to rich conditions; and 2) fuel economy reduction that results from frequent purges of the NOx trap. The specific selection of materials in the front zone of the first catalyst minimizes the oxygen storage function and thus the NOx release is minimized and in turn the fuel required to purge the catalyst. More specifically, the first zone of the first catalyst includes

a catalyst material PM-Rh, and a metal oxide selected from the group consisting of oxides of aluminum, alkali metals, alkaline-earth metals, and combinations thereof — the first zone is devoid of cerium. Reduction of oxygen storage capacity of the lean NOx trap is believed to reduce NOx release during the lean-rich transition. Accordingly, in the claimed invention, the first zone must be devoid of cerium. As set forth in the specification on page 11, “catalyst system 10 minimizes the oxygen storage function in the front zone of the first catalyst, so that NOx release is minimized. The reduction of oxygen storage function in the front zone is also believed to minimize the fuel required to purge the catalyst.” It is thus necessary that the first or front zone/layer in communication with the exhaust stream — the zone that stores most of the NOx, should be devoid of cerium — to prevent the release of unconverted NOx from the NOx trap during the rich fuel cycle.

Rejection Of Claims 1-32 Under 35 U.S.C. § 102(b)
As Being Anticipated By Sung et al.

With the above comments in mind, the Sung prior art reference does not teach every element of the claimed invention. First, the Sung reference teaches that the upstream catalyst is a three-way conversion catalyst, such catalysts cannot optimize storage of NOx under lean air/fuel ratios as required by the claims. Per the amended claims, the upstream catalyst in the claimed system is defined as a lean NOx trap. Second, the Sung reference teaches the use of an oxygen storage component such as ceria, in the top layer of the upstream catalyst. (Sung patent, column 9, lines 20-28.) Accordingly, the Sung reference fails to disclose a first catalyst including a front zone/top layer that is devoid of ceria, as required by claims 1-32. Third, the claimed invention calls for the first zone of the first catalyst to be upstream from the second zone of the first catalyst, and further that this first zone is devoid of cerium, so that NOx is not released. Because these three claim elements are missing, the Sung reference fails to constitute an anticipatory reference.

**Rejection Of Claims 1-32 Under 35 U.S.C. § 103(a)
As Being Unpatentable In View Of Sung et al.**

The Sung reference also fails to render the present invention obvious. First, the Sung reference teaches that the upstream catalyst is a three-way conversion catalyst. In the present invention, the first or upstream catalyst functions as a lean NOx trap — not a three-way catalyst. Rather, it is the downstream catalyst, in the present invention that functions as a three-way catalyst. Moreover, the two problems identified by the present invention, namely, 1) “NOx release,” the release of unreduced NOx from the NOx trap during the transition from lean to rich conditions; and 2) fuel economy reduction that results from frequent purges of the NOx trap, are neither mentioned nor solved in the Sung reference. Applicants understand that the solution to both of these problems involves the specific selection of materials in the two zones of the first catalyst, and in particular the existence of a cerium-free first zone — to solve the above mentioned problems. Accordingly, because the Sung reference does not include a first lean NOx trap catalyst, that includes a cerium-free zone, the Sung reference cannot render the present invention obvious.

**Rejection Of Claim 32 Under 35 U.S.C. § 102(b)
As Being Anticipated By EP 1 108 863 A2**

The EP 1 108 863 A2 reference fails to teach one single catalyst having three zones, wherein the third zone contains a hydrogen sulfide suppressant, to minimize the hydrogen sulfide emissions during desulfations of the second zone without re-poisoning the second zone. Further, the EP reference suggests that “rare earth element(s) (i.e. cerium), zirconium and/or the like may be added to the porous carrier” of the NOx reducing catalyst. (Page 6, lines 51-54.) Accordingly, the EP reference does not anticipate nor render claim 32 obvious.

**Rejection Of Claim 32 Under 35 U.S.C. § 102(b)
As Being Anticipated By Deeba et al.**

The Deeba et al. reference also fails to teach a single catalyst having three zones, wherein the third zone contains a hydrogen sulfide suppressant, to minimize the

hydrogen sulfide emissions during desulfations of the second zone without re-poisoning the second zone. Further, the top layer of catalytic layer E, calls for no rhodium — contrary to the claimed invention which requires a PM-Rh catalyst mixture for all of the layers. Accordingly, the Deeba reference does not anticipate nor render claim 32 obvious.

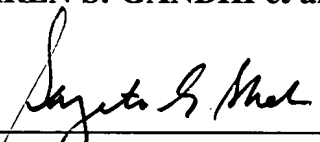
CONCLUSION

For the foregoing reasons, Applicants believe that the Office Action of June 22, 2004 has been fully responded to and, in view of the amendment and remarks, that the application is in condition for allowance. Applicants respectfully request such an allowance and invite the Examiner to contact the undersigned with any questions.

A check in the amount of \$110 is enclosed to cover the Petition fee. Please charge any additional fees or credit any overpayments as a result of the filing of this paper to our Deposit Account No. 02-3978 -- a duplicate of this paper is enclosed for that purpose.

Respectfully submitted,

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